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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Peter A. Hochstein	)	
Application No.:	09/382,702	)	TC Art Unit: 2838
Reissue Filed:	August 24, 1999	)	Examiner: B. Vu
Original Patent:	5,661,645	)	
Issued:	August 26, 1997	)	
For:	POWER SUPPLY FOR LIGHT EMITTING DIODE ARRAY	)	

Commissioner for Patents
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DECLARATION OF PETER A. HOCHSTEIN

I, Peter A. Hochstein, hereby declare as follows:

1. I am the named inventor on the above-identified application, which was filed to reissue my U.S. Patent 5,661,645 ("the original '645 patent"). I am therefore familiar with the technical disclosure of the present application and the original '645 patent; citations herein to the disclosure are to the patent. I have also read numerous references that have been used from time to time in rejections of claims presented in the above-identified application, including U.S. Patent 5,075,601 to Hildebrand, U.S. Patent No. 5,463,280 to Johnson, Brown, M., Power Supply Cookbook, 1994, pp. 25, 26, 72, 73, and 195-225 (Motorola Series in Solid State Electronics; Butterworth-Heineman), and the Motorola data sheet for the MC 34261 controller.

2. I am the same Peter Hochstein who submitted the Declaration of Peter Hochstein, dated December 1, 1998, in *Relume Corp. v. Dialight Corporation et al.*, Case No. 98-CV-

72360, the U.S. District Court final decision reported at 63 F.Supp.2d 788 (E.D. Mich. 1999) ("the previous Hochstein Declaration").

Specification Description of Embodiments of Claimed Invention

3. I am informed that claim 24 as set out below is being submitted in a Preliminary Amendment in the above-identified application concurrently with this Declaration:

> Claim 24. A power supply assembly for powering light emitting diodes (LEDs) in an outdoor line-connected signal, comprising:
>
> an electrical input for coupling to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range when the switch is on;
>
> a rectifier coupled to the electrical input and having a rectifier output;
>
> a line voltage regulating switchmode power supply having a power supply input coupled to the rectifier output and a power supply output;
>
> a plurality of LEDs coupled to the power supply output and having multiple current paths for emitting light in response to the power supply output; and
>
> a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load, the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is within the operating range and an essentially conductive condition if the electrical input voltage drops below a predetermined value lower than the operating range, wherein the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

4. I have compared this claim to the disclosure of the above-identified application, and I find that the disclosure describes an embodiment of a power supply assembly having all of the features recited in claim 24. The following chart explains in detail where in the application describes an embodiment of each of the features in claim 24.

Claim 24	Disclosed Embodiment
A power supply assembly for powering light emitting diodes (LEDs) in an outdoor line-connected signal, comprising:	A power supply assembly 10 connected to an a.c. line voltage powers a light emitting diode array signal 12. Col. 5, lines 11-13; Fig. 5.

an electrical input for coupling to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range when the switch is on;	The assembly 10 includes an electrical input 22 coupled to the a.c. power line through a solid state switch that provides operating voltages from 85 to 140 volts (a nominal 120 volt a.c. line). Col. 5, lines 15-18, col. 6, lines 27-30; Figs. 5, 6a, 6b.
a rectifier coupled to the electrical input and having a rectifier output;	A full wave rectifier 32 is coupled by lines 30 to the electrical input 22 and has an output 34. Col. 5, lines 35-39; Fig. 5.
a line voltage regulating switchmode power supply having a power supply input coupled to the rectifier output and a power supply output;	A line voltage regulating switchmode power supply 38 has an input coupled to the rectifier output 34 and an output 42,44. Col. 5, lines 41-54; Fig. 5.
a plurality of LEDs coupled to the power supply output and having multiple current paths for emitting light in response to the power supply output; and	A plurality of LEDs 16 coupled to the power supply output 42,44 have multiple current paths and emit light in response to the power supply output. Col. 5, lines 5-10, col. 6, lines 24-27; Fig. 5.
a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load,	A circuit 24 includes a low impedance resistor 60 connected in series with a transistor Q2. The circuit 24 "eliminates problems with conflict monitors." Col. 6, lines 57-62, col. 7, lines 12-15, 46-50; Figs. 5, 6a, 6b.
the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is within the operating range and	The bipolar transistor switch Q2 is off ("essentially nonconductive") whenever the traffic controller switch is on to provide the nominal 120 volts (with a range of 85-140 volts) at the electrical input 22 so that a Zener diode D5 reverse-conducts from cathode to anode. Col. 7, lines 45, 63-67; Fig. 6b.
an essentially conductive condition if the electrical input voltage drops below a predetermined value lower than the operating range,	The transistor Q2 is on ("essentially conductive") if the electrical input 22 drops below 40 volts (lower than the 85-140 volt operating range) and prevents the Zener diode D5 from conducting in the reverse direction. Col. 7, lines 53-60; Fig. 6b.
wherein the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.	"If the Zener diode D5 does not conduct, the transistor Q2 is turned on to place the load resistor 60 [in] the power lines 22 causing the leakage voltage [from the solid state switch] to drop below 10 volts." Col. 7, lines 18-30, 59-62; Fig. 6b.

5. I am informed that the Preliminary Amendment also presents claims 28 and 32 similar to claim 24, except that the "line voltage regulating switchmode power supply" of claim 24 is replaced in claim 28 by "a switchmode power supply for maintaining current and voltage waveforms substantially in phase and for providing a regulated current output with respect to variations in the input line voltage," and is replaced in claim 32 by "a switchmode power supply for improving poor power factor, whereby the power supply provides essentially constant current at a power supply output with respect to variations in line voltage input, and whereby current and voltage waveforms are maintained substantially in phase." Embodiments of these power supplies, which are conventional, are generally described at column 5, lines 42-57, of the original '645 patent.

6. I am informed that the Preliminary Amendment also presents the following claim 44 in the above-identified application:

> Claim 44. A conflict monitor compatibility circuit for use in traffic and pedestrian signaling applications, comprising:
>
> a plurality of LEDs for emitting light in response to an electrical input adapted to be coupled to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range when the switch is on;
>
> a transistor biased as a switch that has an essentially nonconductive condition whenever the electrical input voltage is within the operating range and an essentially conductive condition if the electrical input voltage drops below a predetermined value lower than the operating range; and
>
> a low impedance load in series connection with the transistor, wherein the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

It will be readily apparent from the above discussion of claim 24 that the present application contains a description of an embodiment of the circuit recited in claim 44.

7. I am informed that the Preliminary Amendment also presents dependent claims with the following features.

> Claim 46. The assembly according to claim 24, 28, or 32, wherein the conflict monitor compatibility circuit further includes a sensor for providing a control output if the electrical input voltage drops below the predetermined value and a control element for switching the transistor to the essentially conductive condition in response to the control output.
>
> Claim 47 The assembly according to claim 46, wherein the sensor is a Zener diode that conducts in a reverse direction only at voltages above the predetermined value.
>
> Claim 48. The assembly according to claim 47, wherein the control element is a second transistor biased as a switch and having a base coupled to the Zener diode.

8. The chart in paragraph 4 above discusses the Zener diode D5, which in claims 47 and 48 provides an embodiment of a sensor that switches the transistor Q2 on and off at the same predetermined voltage. The control element in the disclosed embodiment is the npn bipolar transistor Q1 that switches the first transistor Q2 on and off when the transistor Q1 is off and on, respectively. Col. 5, lines 4-10, 57-67; Figs. 6a, 6b. I am informed that the Preliminary Amendment also presents dependent claims 51-53 similar to claims 46-48, respectively, but dependent from claim 44. Accordingly, claims 51-53 also recite structure that is described in the context of a preferred embodiment in the disclosure of the present application.

9. It is my understanding that pointing out where the specification describes preferred embodiments of claim features does not limit the claims to those embodiments. Accordingly, the above discussion should not be taken as an indication that I believe that the claims are so limited. In addition, it should be clear that the phrase "coupled to" used in the claims does not require a direct connection between the "coupled" circuit elements. Rather, it refers to the operative interconnection between the elements that enables the claimed structure to operate as claimed.

10. I have noted that Fig. 6a should include a functional connection between the voltage sensing means 48 and the controlled load means 50, as represented in Fig. 6b by the circuit line including the resistor 58. See col. 7, lines 57-59. Accordingly, there should be a line between these two "means" in Fig. 6a to make the drawings consistent with the description in the specification.

Differences Between Claims and U.S. Patent 5,075,601 to Hildebrand

11. This discussion focuses on U.S. Patent 5,075,601 to Hildebrand ("Hildebrand") and the differences between it and the conflict monitor compatibility circuits in independent claims 24, 28, 32, and 44. That should not be taken as an opinion on my part one way or the other as to the relevance to those claims of the other references mentioned in paragraph 1. I will use the conflict monitor compatibility circuit recited in claim 24 as representative of the similarly recited structure in independent claims 28, 32, and 44. That is, any differences among claims 24, 28, 32, and 44 are not specifically relevant to the differences between the claimed invention and Hildebrand.

12. The claimed conflict monitor compatibility circuit is an important feature of power supply assemblies with signals that are lit by LEDs controlled by a solid-state traffic controller switch (as recited in claims 24, 28, 32, and 44) rather than by the long-conventional incandescent lamps. Prior art signals include a conflict monitor circuit as a safety feature. This circuit senses if signals being displayed conflict with each other, such as by showing green lights at intersecting streets. This can happen if, say, a lightning strike creates a power surge that damages the solid state traffic controller switch and causes it to display conflicting green lights. A conflict monitor circuit detects the conflict and initiates remedial action to prevent accidents, such as changing all

of the signals to a flashing-red mode. However, using existing conflict monitor circuits designed for incandescent lamp signals with more modern LED signals can cause false conflict detection. The claimed conflict monitor compatibility circuit solves this problem, and also maintains the low power consumption that is one reason for lighting traffic signals with LEDs in the first place.

13. One source of the false-conflict problem is a difference between the electrical characteristics of LEDs and incandescent lamps. An incandescent lamp that is switched on has a relatively high resistance while generating light. When power to the lamp is off, it exhibits a much lower resistance (impedance). Conflict monitor circuits sense that a lamp is off when a relatively low voltage is present due to the low lamp resistance. When operating properly, the conflict monitor circuit detects if the voltages associated with crossing streets' green lights exceed a predetermined value, indicating that the green lights for both streets are on at the same time. If so, the conflict monitor circuit assumes a traffic controller switch malfunction and changes the intersection to an all-flashing-red mode.

14. LED signals are different because, unlike incandescent lamps, they typically exhibit a relatively high input impedance in the presence of even low currents, such as normal leakage currents from a solid state traffic controller switch that is turned off. These leakage currents do not cause a problem with incandescent lamps because incandescent lamps have a relatively low impedance at these low leakage currents. But with an LED traffic signal, the voltage can be appreciable even when the traffic control switch is turned off. So when LEDs are combined with conflict monitor circuits that use elevated voltage to indicate the existence of a conflict (two "on" green lights at crossing streets), false conflict determinations can occur even if the traffic controller switch is functioning properly. This is because leakage currents, which are present

during normal operation of the solid state traffic controller, are not shunted from the conflict monitor circuit by LED signals as they would be by incandescent lamps. In other words, a green-light LED signal subjected to leakage currents can create a high-voltage "false positive," which the conflict monitor circuit interprets as a lighted LED, even if it is not in fact lit. See original '645 patent, col. 5, lines 15-30; Hildebrand, col. 1, lines 11-33.

15. There were solutions to this problem before the claimed conflict monitor compatibility circuit, but none of them enabled full advantage to be taken of the low power consumption of LEDs as compared to other types of illuminating devices such as incandescent lamps or luminescent (neon or fluorescent) lights. One solution was placing a large capacitor across the inputs to the LEDs to absorb the leakage currents. This defeated the purpose of using LEDs for their low power consumption because of the reactive power drawn by the capacitor. See original '645 patent, col. 5, lines 23-30. Another solution is shown in Hildebrand, which was used to reject the claims, but as discussed below, Hildebrand's "dynamic load circuit," like a capacitor, also mitigates the advantages of using LEDs in the first place.

16. The following language in particular distinguishes the claimed invention from prior art traffic signal circuitry such as that shown in Hildebrand:

> a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load, the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is within the operating range and an essentially conductive condition if the electrical input voltage drops below a predetermined value lower than the operating range, wherein the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

17. The claimed conflict monitor compatibility circuit includes a transistor biased as a switch, so that a low impedance load is either out of the circuit (the transistor is in the essentially

nonconductive condition), whenever the electrical input voltage is within its operating range, or is coupled to the electrical input (the transistor is in the essentially conductive condition), if the electrical input voltage drops below a predetermined value lower than the operating range. The essentially nonconductive condition thus exists any time the solid state traffic controller switch is on, meaning that the electrical input voltage is in its operating range (between, say, 85 and 140 volts; see original '645 patent, col. 6, lines 27-30, col. 7, lines 63-67). However, if the electrical input voltage drops below a predetermined value (say, 40 volts; see original '645 patent, col. 7, lines 41-46), which indicates that the solid state traffic controller switch is off and the sensed voltage is due to leakage currents, the transistor is in its essentially conductive condition. This couples the low impedance load to the electrical input to reduce the leakage voltage to a value that is consistent with the proper operation of the conflict monitor circuit (say 10 volts; see original '645 patent, col. 7, lines 47-48). Shunting the leakage current through the low impedance load in this manner enables proper operation of the conflict monitor circuit because the artificially elevated leakage voltage cannot trigger a false conflict. In other words, the conflict monitor circuit will detect a low voltage (indicative of a low impedance), just as it would if the traffic signal used incandescent lamps, thus making prior art conflict monitor circuits compatible with LED-lit signals by preventing high-voltage, "false positive" conflict indications.

18. During the pendency of the present application, the Examiner has contended that Hildebrand's dynamic load circuit shown in Fig. 1A corresponds to the present conflict monitor compatibility circuit. The Examiner has equated Hildebrand's MOSFET transistor Q3 and resistor R7 to the transistor and low impedance load, respectively, of the conflict monitor compatibility circuit as claimed in prior versions of claims 24, 28, 32, and 44.

19. Hildebrand's circuit operates in a manner that at first glance might seem similar to the claimed conflict monitor compatibility circuit. One of the purposes of Hildebrand's "dynamic load circuit" is to deal with leakage currents from a solid state controller switch. Col. 1, lines 15-18. Hildebrand says that its dynamic load circuit ensures that in a power-off condition "external alternating leakage current cannot create appreciable voltages at the input terminals." Col. 6, lines 60-65. Finally, Hildebrand recognizes that leakage current can cause a false conflict indication. Col. 1, lines 28-41.

20. But Hildebrand's circuit for solving this problem differs from the conflict monitor compatibility circuit claimed in the present application. A major difference between Hildebrand's dynamic load circuit and the claimed conflict monitor compatibility circuit resides in the transistor coupled to the electrical input, which transistor is "biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is within the operating range and an essentially conductive condition if the electrical input voltage drops below a predetermined value lower than the operating range." This transistor is different from Hildebrand's MOSFET Q3 in both structure and function.

21. The claimed transistor of the present application is "biased as a switch," and Hildebrand's MOSFET Q3 is an amplifier. These are mutually exclusive ways to structure a transistor. See, for example, Lovell, B., et al., Lecture 12: 9E103 Electrical Physics and Electronics, University of Queensland, Nov. 5, 2000, http://www.itee.uq.edu.au/~engg1030/lectures/1perpage/lect12.pdf#search=%22lecture%2012%20transistor%22, last visited October 12, 2006 (copy attached as Exhibit A). As explained in Lovell at pages 1-6, a transistor used as an amplifier is biased to ensure that the transistor

operates in a desired current range. Hildebrand's Fig. 4 shows the operating range of the MOSFET amplifier transistor Q3; at column 6, lines 17-36, Hildebrand discusses the circuitry that provides the operating characteristics shown in Fig. 4. At page 10, Lovell sums up the difference between a transistor amplifier (like Hildebrand's MOSFET Q3) and a transistor switch (like that claimed):

- For an amplifier, we want the transistor to operate in the linear region between cutoff and saturation [the dot-dash phantom line in Hildebrand's Fig. 4]

- For a switch, we drive the transistor between cutoff and saturation regions.

22. Thus, the claimed circuit operates differently from Hildebrand's. The claimed transistor switch is in "an essentially nonconductive condition whenever the electrical input voltage is within the operating range." In contrast, Hildebrand's MOSFET Q3 is in an essentially conductive condition even in the operating range (nominally 115 volts a.c., see col. 2, line 32).

23. This is seen in Hildebrand's Fig. 4, and is described at column 6, lines 11-15: "the circuit is such that the current decreases over part of its operating region with increasing voltage. This characteristic is shown, for example, in the curve of Fig. 4." In other words, although Q3's conductivity varies, it is not in a nonconductive condition <u>whenever</u> the electrical input voltage is in the operating range. The current-voltage characteristic of MOSFET Q3 (the dot-dash phantom line in Fig. 4) confirms that Q3 conducts throughout the device's operating region (when leakage currents are not present), with its conductivity increasing linearly as the voltage decreases. It is true that Hildebrand's MOSFET Q3 is conductive in the presence of leakage currents from the solid state switch controlling the traffic signal (see, for example, col. 1, lines 15-18). But the solid line in Fig. 4 shows that <u>Hildebrand's MOSFET is also conductive in the operating range</u>.

24. I performed tests that further demonstrate the differences between the claimed conflict monitor compatibility circuit and Hildebrand's dynamic load circuit. The test results are presented in Exhibit 4 to the previous Hochstein Declaration (a copy of Exhibit 4 is attached as Exhibit B).

25. Exhibit B directly compares the voltage-current characteristic of Hildebrand's circuit with that of the claimed conflict monitor compatibility circuit. The plot in Exhibit B labeled "Hildebrand Current" was generated using a circuit built in accordance with Hildebrand's disclosure. The voltage and current were measured at the input (the fused circuit lines at the far left in Hildebrand's Fig 1A). That plot closely matches the shape of the voltage-current characteristic in Fig. 4 of Hildebrand, in which the MOSFET transistor Q3 is conductive at essentially all voltages. In sharp contrast, the plot for the claimed switch-biased transistor/low impedance load ("Relume's Current") is conductive at low voltages, but is nonconductive at voltages above about 20 VAC. The current and voltage were measured at the electrical input 22 (downstream of the solid state traffic controller switch) in a circuit as shown in Fig. 5.

26. The second plot comprising Exhibit B shows the drastic difference between the power dissipated by Hildebrand's circuit as compared to almost no power dissipation using the claimed circuit. This plot illustrates at a glance that the claimed invention slashes the power consumption of Hildebrand's circuit. Hildebrand's low impedance load (resistor R7) remains in the circuit, drawing current, even in the operating range. But because the claimed switching transistor is in a nonconductive condition in the operating range (that is, when there is no leakage current), the low impedance load is completely out of the circuit during normal operation. Thus, the claimed circuit preserves one of the main reasons for using LEDs in the first place: their low

power consumption. For example, at 115 VAC, Hildebrand's dynamic load circuit consumes about 2.4 watts, while the claimed circuit would consume only 0.3 watts. Thus, the amount of power consumed by Hildebrand's dynamic load circuit during normal operation would be a significant fraction of the total power consumed by an LED traffic signal, typical ratings for which at the time of the present invention were about 14-20 watts. Original '645 patent, col. 1, line 62, to col. 2, line 2. Indeed, more recent LED traffic signals are rated as low as 6 watts, making the claimed circuit even more advantageous as compared to Hildebrand's dynamic load circuit. "Hi-Flux LED Modules – 433 Series Traffic Signals," Dialight Specification Sheet, http://www.dialight.com/pdf/TrafficSignals/MDTS433EXCAL001_A-W.pdf, last visited October 12, 2006 (copy attached as Exhibit C).

27. Another way of comparing the claimed conflict monitor compatibility circuit to Hildebrand is to consider whether it would have been obvious to replace Hildebrand's MOSFET transistor amplifier Q3 with a switch-biased transistor having the claimed operational properties. When viewed from that perspective, it is even clearer that Hildebrand would not have suggested the claimed circuit. No prior art document I am aware of suggests making such a substitution, nor that it would result in a drastic reduction in power consumption. In fact, there would have been little motivation to use the claimed compatibility circuit, with its lower power consumption, in Hildebrand's luminescent-tube signal, since the 2.4 watts consumed by Hildebrand's dynamic load circuit at the nominal operating voltage is still a relatively small fraction of the power consumed by the typical fluorescent or neon lamp.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that the

statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title XVIII of United States Code, and that such willful false statements made jeopardize the validity of this application or any patent issued thereon.

Date: April 12, 2007

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